Lamp envelope

Publication number: GB1139622

Publication date: 1969-01-08

Inventor:

Applicant: OWENS ILLINOIS INC

Classification:

- international: ***C03C3/083; C03C3/112; C03C8/24; C04B37/04; C25D13/24; F21V3/04; H01J5/04; H01J5/24; H01K1/36;*** **C03C3/076; C03C8/00; C04B37/04; C25D13/22; F21V3/00; H01J5/00; H01J5/02; H01K1/00;**

- european: C03C3/083; C03C3/112; C03C8/24; C04B37/04; C25D13/24; F21V3/04; H01J5/04; H01J5/24; H01K1/36

Application number: GB19670035261 19670801

Priority number(s): US19660569250 19660801

Also published as:

US3451579 (A1)
NL6710554 (A)
FR1550145 (A)
FR1139622 (A)

Abstract of **GB1139622**

1,139,622. Glass-ceramic to silica glass seals. OWENS-ILLINOIS Inc. 1 Aug., 1967 [1 Aug., 1966], No. 35261/67. Heading C1M. A glass-ceramic lamp envelope is sealed to a silica glass window, both having compatible low coefficients of thermal expansion of less than 25 Î 10<SP>-7</SP>/ C. (0-300 C.) preferably between 4 and 10 by a vitreous copper containing sealing glass consisting of in mole percentages: SiO 2 75-80; Al 2 O 3 8-12; Cu 2 O 10-15; and optimally AlF 3 1-4. Fused silica or quartz may be used for the window in any well known type of lamp and sealing is affected in an oven in an atmosphere of nitrogen or by flame sealing. The solder glass may be applied to the rim either of the silica window or the glass-ceramic envelope and in any form such as a bead or paste. A fibre of the solder glass may be applied to the edge by a hand torch. Particles in an organic binder, for which examples are given, may be applied as a paste. Examples of glassceramics in weight percentages are: (1) (2) (3) SiO 2 69 69À9 64À1 Al 2 O 3 19 18 20À9 CaO 4 4 2À7 Li 2 O 3À8 4 3À7 TiO 2 1À8 - 1À8 ZrO 2 2 3À5 2 Na 2 O 0À1 0À1 0À5 Sb 2 O 3 0À3 0À3 - B 2 O 3 - - 2À9 ZnO - - 1-3 As 2 O 3 - - 0À1 The sealing glasses are described and classed in Specification 1,132,885.

1,139,622

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,139,622

Date of Application and filing Complete Specification: 1 Aug., 1967.
No. 35261/67.
Application made in United States of America (No. 569250) on 1 Aug., 1966.
Complete Specification Published: 8 Jan., 1969.

Index at acceptance:—C1 M(5A, 5D1, 5D12, 11B3, 11C4, 11C5, 11C9, 11F1, 11F2, 11F3, 11F29, 11F33, 11F34, 11J3, 11K1, 19C2B, 19D8B, 19D8D, D15, D21, D22, D27, S5, S9A, S13, S19)

Int. Cl.:—**C 03 b 23/20**

COMPLETE SPECIFICATION

Lamp Envelope

We OWENS-ILLINOIS, INC. a Corporation organised under the laws of the State of Ohio, United States of America, of Toledo, Ohio, United States of America, (Assignee of FREDERICK LENDALL BISHOP), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an article of manufacture; and, more particularly, the instant invention pertains to an article assembled of separate prefabricated parts to form thereby a single item. Specifically, the subject invention relates to a novel lamp envelope consisting of glass-ceramic and quartz parts intimately joined to form a composite lamp.

Ultra-violet transmitting and infrared heat transmitting lamps are widely used in science and commerce. The ultra-violet transmitting lamps are generally of the mercury vapor type, and they are routinely used as run lamps and bactericidal lamps. Infrared lamps, because of their ability to heat the object, which receives the radiation, are commonly used for drying paints, inks and adhesives, for baking and cooking various foods, for spectrophotometry, night driving and other like uses. The infrared radiation source as used extensively for the purposes of science and commerce generally involves tungsten-filaments, mercury and xenon high intensity short arc, cesium vapor arc lamps and other special sources.

The lamps as used for the purposes mentioned supra are fabricated in various sizes and shapes, such as tubular, single screw base, double base and as reflector-type lamps. In the manufacture of the above type lamps, various glasses, such as fused silica glass, arsenic trisulfide glasses, arsenic-modified selenium glass, tellurate glass, calcium aluminate glasses, and the like, are used for lamp construction, for example, for housing the filaments and to transmit the infrared radiation or the ultra-violet light. The use of these glasses for the lamp construction is often very expensive, and the lamp envelope made of said glasses, for example, all fused silica, often are fragile and lack directional guidance for the energy produced. Therefore, it will be appreciated by those skilled in the art that if a less expensive, stronger and directional lamp were made available, it would represent a useful contribution to the art, and increase its use in commerce.

It has now been found possible to provide a novel means for fabricating a lamp, particularly mercury, infrared lamps and the like. There is provided a lamp possessing a body with good thermal and mechanical properties such as a lamp made of a preformed glass-ceramic body with a window of fused silica, having complemental relatively low coefficient of thermal expansion.

It has now been found in the present invention that the mercury vapor and infrared lamps may be made from low expansion glass-ceramics and from fused quartz. The low expansion glass-ceramic is conveniently employed for the body, or bulb envelope of said lamps, and the fused quartz is used as a face or as a window for transmitting the produced energy. The silica window as employed in the lamp of the present invention may be used in lamps of common shapes and sizes, for example, tubular, pear shaped, round, bowl, parabolic or globular, and the like. The fused quartz window of the subject lamp is intimately sealed to the glass-ceramic body of the lamp at the desired point.

According to the present invention there is provided a composite lamp article which com-

prises sealed parts, said parts comprising a preformed hollow low thermal coefficient of expansion glass-ceramic envelope and a preformed radiant energy transmitting low expansion silica glass window, both having compatible low coefficients of thermal expansion not in excess of 27×10^{-7}/°C (0—300°C.), the latter intimately bonded to said envelope by a vitreous copper-containing sealing glass comprising the following components in the indicated mole per cent amounts based on the total glass: 75 to 80 mole percent SiO_2, 8 to 12 mole percent Al_2O_3, and 10 to 15 mole percent Cu_2O, (as herein defined), the balance, if any, consisting of other compatible ingredients.

A copper-containing glass composition having the following components in the indicated mole per cent amounts based on the total composition:

Component	Mole Percent
SiO_2	50 to 94
Al_2O_3	0.5 to 30
Cu_2O (as herein defined)	1.5 to 35

the balance, if any, consisting of other compatible ingredients, is described and claimed in our Specification 1132885.

The term Cu_2O means either cuprous oxide or a mixture of cuprous oxide and cupric oxide.

The low expansion glass-ceramics and fused quartz that can be used in the mode and manner of the invention are the commercially available low expansion glass-ceramics, fused quartz and fused silica. In the present case, the expressions "fused quartz" and "fused silica" are used interchangeably, and they are to be construed as functionally equivalent. Generally, by glass-ceramics as used herein is meant the low expansion essentially thermal shock resistant glass-ceramics having a coefficient of expansion of less than about 25×10^{-7}/°C (0—300°C) and preferably about 20×10^{-7}/°C (0—300°C) or less and possess good working characteristics to facilitate the manufacture of the lamp body by conventional working techniques such as blowing, pressing or spinning techniques. As examples of low expansion glass-ceramic may be cited a glass-ceramic composition comprising, in weight percent, 69% SiO_2, 19% Al_2O_3, 4% CaO, 3.8%, Li_2O, 1.8% TiO_2, 2% ZrO_2, 0.1% Na_2O, and 0.3% Sb_2O_3, with a heat treatment period at 1375° for 480 hours with an expansion of 0.6×10^{-7}/°C (0—300°C); a glass ceramic consisting essentially of 69.9% SiO_2, 18% Al_2O_3, 4% CaO, 4% Li_2O, 3.5% ZrO_2, 0.1% Na_2O, and 0.3% Sb_2O_3, with a thermal coefficient of 0.5×10^{-7}/°C (0—300°C); and a composition consisting of 64.1% SiO_2, 20.9% Al_2O_3, 2.7% CaO, 3.7% Li_2O, 1.8% TiO_2, 2% ZrO_2, 0.5% Na_2O, 2.9% B_2O_3, 1.3% ZnO, and 0.1% As_2O_3, with an annealing point for the glass of 1225°F., a heat treating period of 64 hours at 1325°F with a coefficient of expansion of 3.1×10^{-7}/°C (0—300°C), the glass ceramics disclosed in Specification 1043024, and other like low expansion glass-ceramic compositions. The abovementioned glass-ceramics are cited as exemplary and are not to be construed as limiting, as other suitable materials known to those versed in the art may be used in the mode and manner of the present invention.

According to the practice of the invention, a thin layer of about 0.1 to about 5 millimeters of a vitreous solder glass composition is employed to intimately bond the fused silica window to the ceramic body of the lamp. The solder glasses employed herein comprise 75 to 80 mole percent SiO_2, 8 to 12 mole percent AlO_3, 10 to 15 mole percent Cu_2O, and a solder glass comprising 75 to 80 mole percent SiO_2, 8 to 12 mole percent Al_2O_3, 10 to 15 mole percent Cu_2O, and 1 to 3 mole percent AlF_3. Examples of now preferred sealing glasses employed for sealing the quartz window to the ceramic are glasses of 77.5 mole percent SiO_2, 10 mole percent Al_2O_3, and 12.5 mole percent Cu_2O, and a glass consisting of 77.0 mole percent SiO_2, 9.3 mole percent Al_2O_3, 1.3 mole percent AlF_3, and 12.5 mole percent Cu_2O. The solder glass compositions reported herein were prepared from Kona Quintas Quartz, Alcoa A-14 Alumina, AlF_3, Cu_2O, or a high cupric mixture consisting of 15% CuO and 85% Cu_2O to give the desired mole percent of Si_2O, Al_2O_3, Cu_2O and AlF_3. The size of the melt was generally about 5 to 30 kilograms, and the compositions were prepared by blending the batch ingredients, melting in a 90% platinum — 10% rhodium or a fused silica container crucible at 1500 to 1600°C for 15 to 16 hours in a gas fired furnace using a slight excess of oxygen.

In attaining the article of the invention, the two parts to be joined, that is, the envelope and the window, are sealed by a vitreous sealing glass consisting essentially of 77.5 mole percent SiO_2, 10 mole percent Al_2O_3, and 12.5 mole percent Cu_2O. The solder glass may be applied to the edge surface of the fused quartz window, which may be of any desired geometrical shape, for example square or round, or to a like surface of the low expansion glass ceramic. The solder glass may be applied in any conventional manner such as bead or paste form. For example, the sealing glass previously drawn into a fiber form was applied to a glass ceramic surface by a hand torch equipped with a No. 3 tip and fueled by a mixture of gas and oxygen. Other seals were fabricated employing a hydrogen-oxygen flame. At no time was the quartz or ceramic surface heated hot enough to glaze the edge or to produce distortion of

said surfaces. Typical seals or joints can also be effected by applying a slurry comprising finely divided solder glass particles in a suitable organic vehicle or carrier onto one or both of the surfaces to be sealed. The slurry composition, which is approximately the consistency of putty, consists of, for example, the powdered or particles of the sealing glass in nitrocellulose dissolved in amylacetate, with a concentration of about 1 to 3% nitrocellulose in said amylacetate. Other acceptable organic binders may be employed provided they will readily burn off and volatize during the heating procedure of the glass-ceramic to fused quartz seal. In addition, the organic binder should not react with any of the elements making up the bonded assembly. As examples of other organic binders which can be used include gelatine dissolved in water, nitrocellulose and butylacetate, camphor with cellulose nitrate and the like.

In addition to the well-known use of a flame to effect sealing with a solder glass, the assembling of the preformed quartz and low expansion glass-ceramic parts can be effected by sealing in an oven. For example, the powdered sealing glasses, mixed with a nitrocellulose and amylacetate is applied to at least one of the surfaces to be sealed, and the sealable parts are then intimately joined in an oven at 2200°F, in a nitrogen atmosphere for 15 minutes.

The coefficient of thermal expansion of fused silica is generally about 5 to 6×10^{-7}/°C and it is, therefore, difficult to join to a low expansion glass-ceramic body having an expansion in a different range than fused silica. The solder glasses as employed herein possesses an expansion coefficient of about 4 to 10×10^{-7}/°C and are, therefore, suitable for bonding a fused quartz window to a low expansion glass-ceramic bulb type envelope.

The bulbs of the present invention may be of the common lamp-bulb shapes, and the accompanying drawings are to be liberally construed as illustrative of assembled bulb constructions.

In the accompanying drawings:

Figure 1 shows a conventional pear-shaped bulb wherein the bulb envelope 10 is a low expansion glass-ceramic intimately bonded by a solder glass 12 to a fused quartz window 11.

Figure 2 depicts a tubular lamp of a glass-ceramic envelope 10 with a quartz window 11 intimately bonded to said envelope by solder glass 12.

WHAT WE CLAIM IS:—

1. A composite lamp article which comprises sealed parts, said parts comprising a preformed hollow low thermal coefficient of expansion glass-ceramic envelope and a preformed radiant energy transmitting low expansion silica glass window, both having compatible low coefficients of thermal expansion not in excess of 25×10^{-7}/°C (0—300°C.), the latter intimately bonded to said envelope by a vitreous copper-containing sealing glass comprising the following components in the indicated mole per cent amounts based on the total glass: 75 to 80 mole percent SiO_2, 8 to 12 mole percent Al_2O_3, and 10 to 15 mole percent Cu_2O (as herein defined), the balance, if any, consisting of other compatible ingredients.

2. An article as claimed in claim 1 in which the vitreous copper-containing sealing glass includes 1 to 4 mole percent AlF_3.

3. An article as claimed in claim 1 or 2 in which sealing glass contains 77.5 mole percent SiO_2, 10 mole percent Al_2O_3, and 12.5 mole percent Cu_2O.

4. An article as claimed in claim 2 in which the sealing glass contains 77 mole percent SiO_2, 9.3 mole percent Al_2O_3, 1.3 mole percent AlF_3 and 12.5 mole percent Cu_2O.

5. An article as claimed in any of claims 1 to 4 in which the silica glass window is comprised of used quartz.

6. An article as claimed in any of claims 1 to 4 in which the silica glass window is comprised of fused silica.

7. An article as claimed in any of claims 1 to 6 in which the ceramic envelope has a coefficient of thermal expansion less than 20×10^{-7}/°C. over the range of 0 to 300°C.

8. A composite lamp article substantially as hereinbefore described with particular reference to and as illustrated in either Figure of the accompanying drawings.

W. P. THOMPSON & CO.,
12, Church Street, Liverpool. 1.
Chartered Patent Agents.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1969.
Published by the Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

1139622 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

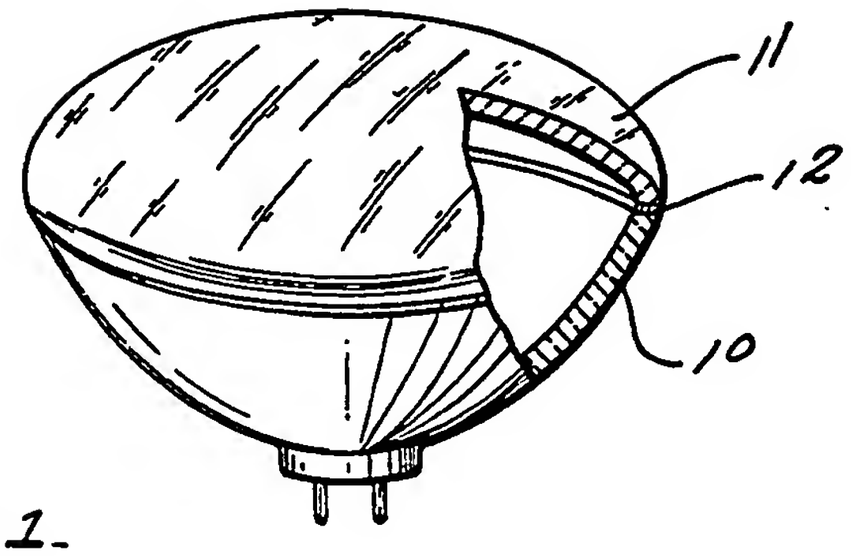

FIG. 1.

FIG. 2.